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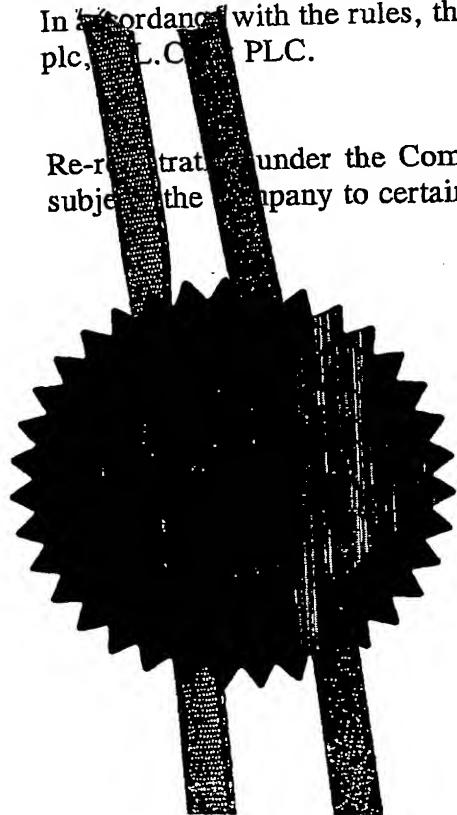
WIPO PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Signed

Dated

P. Mahoney
15 October 2004

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27 OCT 03 1347291-1/0420293
P01/7700 0.00-0324912.5**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office

 Cardiff Road
Newport
South Wales
NP10 8QQ
1. Your reference

ACC/PB60556P

2. Patent application number

(The Patent Office will fill this part in)

0324912.5**3. Full name, address and postcode of the or of each applicant (underline all surnames)**
 GLAXO GROUP LIMITED
GLAXO WELLCOME HOUSE
BERKELEY AVENUE
GREENFORD
MIDDLESEX. UB6 0NN
GB

Patents ADP number (if you know it)

473587003

If the applicant is a corporate body, give the country/state of its incorporation

GB

4. Title of the invention**PHARMACEUTICAL FORMULATIONS****5. Name of your agent (if you have one)**

A C CONNELL

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

 GLAXOSMITHKLINE
CORPORATE INTELLECTUAL PROPERTY (CN9 25.1)
980 GREAT WEST ROAD
BRENTFORD
MIDDLESEX
TW8 9GS

Patents ADP number (if you know it)

8072555006

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country

Priority application number
(if you know it)Date of filing
(day / month / year)**7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)**Number of earlier UK application
Date of filing
(day / month / year)**8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?**

YES

Answer YES if:

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

Otherwise answer NO (See note d)

9. **Accompanying documents:** A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form

| | | |
|-------------|----|---|
| Description | 15 |  |
| Claim(s) | 2 | |
| Abstract | | |
| Drawing(s) | 1 | |

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

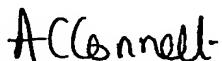
Request for a preliminary examination and search (Patents Form 9/77)

Request for a substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature(s) A C CONNELL, Agent for the Applicant



Date 24 October 2003

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Andrew Shore
01438 764024

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Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered YES in part 8, a Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

PHARMACEUTICAL FORMULATIONS

The present invention relates to solid pharmaceutical formulations which comprise an active ingredient drug substance, a carrier and calcium stearate. The invention also relates to the 5 use of calcium stearate for the stabilisation of the active ingredient drug substance in the presence of a carrier.

An important requirement of pharmaceutical formulations is that they should be stable on storage in a range of different conditions. It is known that active ingredient substances can 10 demonstrate instability to one or more of heat, light or moisture and various precautions must be taken in formulating and storing such substances to ensure that the pharmaceutical products remain in an acceptable condition for use over a reasonable period of time, such that they have an adequate shelf-life. Instability of a drug substance may also arise from contact with one or more other components present in a formulation, for example a 15 component present as an excipient.

It is usual practice in the pharmaceutical art to formulate active ingredient substance with substances known as excipients which may be required as carriers, diluents, fillers, bulking agents, binders etc. Such excipients are often used to give bulk to a pharmaceutical 20 formulation where the active ingredient substance is present in very small quantities. Such substances are generally chemically inert. Over prolonged storage times, or under conditions of extreme heat or humidity, and in the presence of other materials, such inert substances can, however, undergo or participate in chemical degradation reactions.

25 Carrier substances that are commonly utilised in solid pharmaceutical formulations include reducing sugars, for example lactose, maltose and glucose. Lactose is particularly commonly used. It is generally regarded as an inert excipient.

However, it has been observed that certain active ingredient substances may undergo a 30 chemical reaction in the presence of lactose and other reducing sugars. For example, it was reported by Wirth *et al.* (*J. Pharm. Sci.*, 1998, 87, 31-39) that fluoxetine hydrochloride (sold under the tradename Prozac®) undergoes degradation when present in solid tablets with a lactose excipient. The degradation was postulated to occur by formation of adducts via the Maillard reaction and a number of early Maillard reaction intermediates were identified. The

authors conclude that drug substances which are secondary or primary amines undergo the Maillard reaction with lactose under pharmaceutically relevant conditions.

5 The present inventors have found that, under accelerated stability conditions, certain inhalable active ingredient substances also undergo degradation in the presence of lactose, possibly also via the Maillard reaction.

10 Some inhalable dry powder pharmaceuticals are sensitive to moisture, as reported, for example in WO 00/28979 (SkyePharma AG). The presence of moisture was found to interfere with the physical interaction between a carrier and a drug substance and thus with the effectiveness of drug delivery. Such interference with physical interactions between a carrier and a drug substance is distinct from chemical instability resulting from degradation.

15 WO01/78694 (Vectura Limited) describes a powder for use in a dry powder inhaler including an active ingredient particles and carrier particles, wherein the carrier includes an additive which is able to promote release of the active particles from the carrier particles. Possible additive materials include calcium stearate.

20 20 We have now surprisingly found that chemical interaction of active ingredient substance and carrier may be inhibited or reduced by the presence of a calcium stearate ternary agent.

25 In a first aspect therefore the present invention provides the use of calcium stearate to inhibit or reduce chemical interaction between an active ingredient substance and a carrier in a solid pharmaceutical formulation, wherein the active ingredient substance is susceptible to chemical interaction with the carrier.

30 The invention also provides the use of calcium stearate to inhibit or reduce chemical degradation of an active ingredient substance in a solid pharmaceutical formulation comprising the active ingredient substance and a carrier, wherein said active ingredient substance is susceptible to chemical interaction with said carrier. The chemical stability of the active substance in the formulation during long term storage is thereby improved.

In a second aspect the present invention provides a solid pharmaceutical formulation comprising (a) an active ingredient substance susceptible to chemical interaction with a carrier, (b) a carrier and (c) calcium stearate.

5 In a third aspect the present invention provides a method of reducing or inhibiting chemical interaction between an active ingredient substance and a carrier susceptible to chemical interaction, which comprises mixing with said active ingredient substance and said carrier calcium stearate. The invention also provides a method of inhibiting chemical degradation of an active ingredient substance in a formulation comprising a carrier and an active ingredient 10 substance, which method comprises mixing calcium stearate with said active ingredient substance and said carrier.

Pharmaceutical formulations according to the present invention have greater chemical stability than the corresponding formulations without said ternary agent.

15 'Ternary agent' is used herein to mean a compound used in a formulation in addition to the active ingredient drug substance or substances (the 'primary' agent) and a bulk carrier material or materials (the 'secondary' agent). In some circumstances more than one ternary agent may be used. Optionally, further substances, possibly named 'quaternary agents', 20 may also be present, for example as a lubricant. Any particular ternary or quaternary agent may have more than one effect.

In the present invention, the calcium stearate ternary agent is capable of reducing or 25 inhibiting interaction between a carrier and an active ingredient in a solid pharmaceutical formulation.

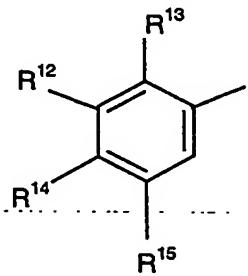
The invention finds particular application in formulations in which the carrier is a reducing sugar, for example lactose, maltose or glucose (for example monohydrate glucose or anhydrate glucose). In a preferred embodiment, the carrier is lactose. Alternative carriers 30 include maltodextrin.

The optimal amount of calcium stearate present in a particular composition varies depending on the identity of the active ingredient drug substance present, the sizes of the particles and various other factors. In general, calcium stearate is preferably present in an amount of from 35 0.1 to 20% w/w based on the total weight of the composition. More preferably the calcium

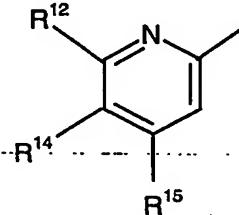
stearate is present in an amount of from 0.2 to 10% w/w based on the total weight of the composition. Still more preferably, it is preferably present in an amount of from 0.3 to 6% w/w, for example from 0.5 to 4% w/w.

- 5 The active ingredient substance is typically present in an amount of from 0.01% to 50% w/w based on the total weight of the composition. Preferably, the active ingredient substance is present in an amount of from 0.02% to 10% w/w, more preferably in an amount of from 0.03 to 5% w/w, for example from 0.05% to 1% w/w, for example 0.1% w/w.
- 10 Preferably, the active ingredient drug substance is one which includes the group Ar-CH(OH)-CH₂-NH-R.

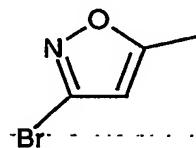
Preferably, the group Ar is selected from



(a)



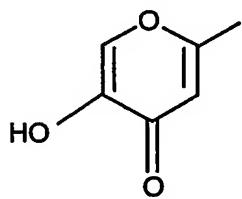
(b)



(c)

15

and



(d)

wherein R¹² represents halogen, -(CH₂)_qOR¹⁶, -NR¹⁶C(O)R¹⁷, -NR¹⁶SO₂R¹⁷, -SO₂NR¹⁶R¹⁷, -NR¹⁶R¹⁷, -OC(O)R¹⁸ or OC(O)NR¹⁶R¹⁷, and R¹³ represents hydrogen, halogen or C₁₋₄ alkyl;

or R^{12} represents $-NHR^{19}$ and R^{13} and $-NHR^{19}$ together form a 5- or 6- membered heterocyclic ring;

5. R^{14} represents hydrogen, halogen, $-OR^{16}$ or $-NR^{16}R^{17}$;

R^{15} represents hydrogen, halogen, halo C_{1-4} alkyl, $-OR^{16}$, $-NR^{16}R^{17}$, $-OC(O)R^{18}$ or $OC(O)NR^{16}R^{17}$;

10. R^{16} and R^{17} each independently represents hydrogen or C_{1-4} alkyl, or in the groups $-NR^{16}R^{17}$, $-SO_2NR^{16}R^{17}$ and $-OC(O)NR^{16}R^{17}$, R^{16} and R^{17} independently represent hydrogen or C_{1-4} alkyl or together with the nitrogen atom to which they are attached form a 5-, 6- or 7-membered nitrogen-containing ring;

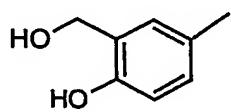
15. R^{18} represents an aryl (eg phenyl or naphthyl) group which may be unsubstituted or substituted by one or more substituents selected from halogen, C_{1-4} alkyl, hydroxy, C_{1-4} alkoxy or halo C_{1-4} alkyl; and

q is zero or an integer from 1 to 4;

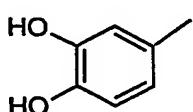
20

A physiologically functional derivative of a drug substance, for example of one of the above-mentioned compounds, may also be used in the invention. By the term "physiologically functional derivative" is meant a chemical derivative of a compound of having the same physiological function as the free compound, for example, by being convertible in the body thereto. According to the present invention, examples of physiologically functional derivatives include esters, for example compounds in which a hydroxyl group has been converted to a C_{1-6} alkyl, aryl, aryl C_{1-6} alkyl, or amino acid ester.

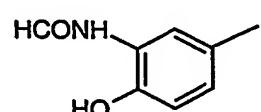
25. Within the definitions of (a) and (b) above, preferred groups may be selected from the following groups (i) to (xxi):



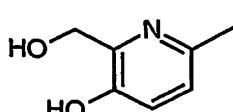
(i)



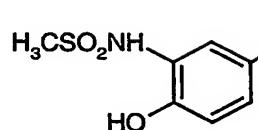
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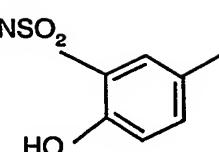
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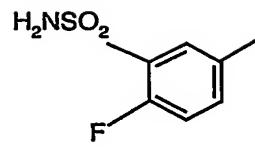
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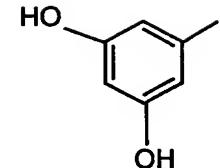
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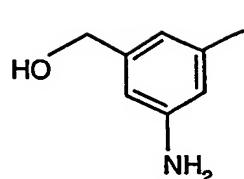
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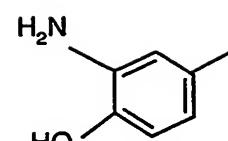
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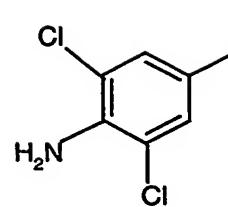
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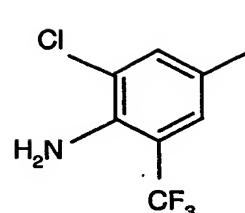
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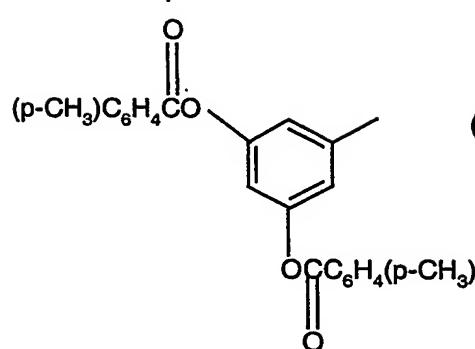
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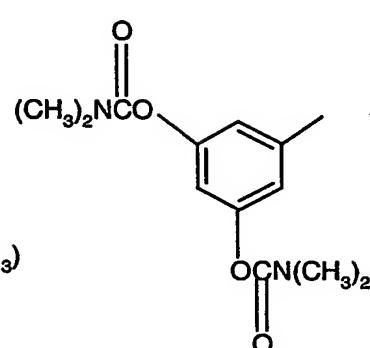
(xi)



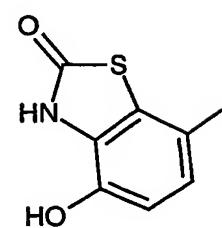
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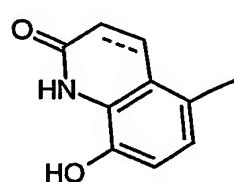
(xiii)



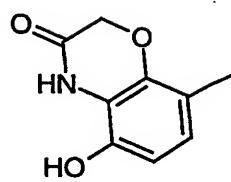
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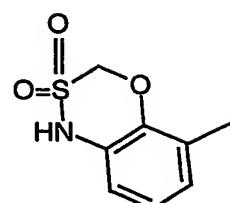
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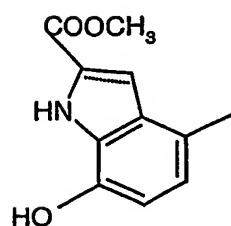
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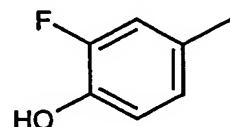
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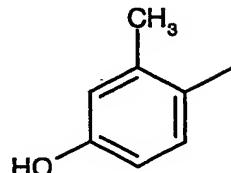
(xviii)



(xix)



(xx)



(xxi)

wherein the dotted line in (xvi) and (xix) denotes an optional double bond.

5 The group R preferably represents a moiety of formula:

-A-B-C-D

Wherein

A may represent $(CH_2)_m$ wherein m is an integer from 1 to 10;

10 B may represent a heteroatom, e.g. oxygen;

C may represent $(CH_2)_n$ wherein n is an integer from 1 to 10; and

D may represent an aryl group, e.g. an optionally substituted phenyl or pyridyl group.

15 The active ingredient drug substance may be present as a salt or a solvate. Salts and solvates which are suitable for use in medicine are those wherein the counterion or associated solvent is pharmaceutically acceptable.

Suitable salts for use in the invention include those formed with both organic and inorganic acids or bases. Pharmaceutically acceptable acid addition salts include those formed from 20 hydrochloric, hydrobromic, sulphuric, citric, tartaric, phosphoric, lactic, pyruvic, acetic, trifluoroacetic, triphenylacetic, phenylacetic, substituted phenyl acetic eg. methoxyphenyl acetic, sulphamic, sulphanilic, succinic, oxalic, fumaric, maleic, malic, glutamic, aspartic, oxaloacetic, methanesulphonic, ethanesulphonic, arylsulponic (for example p-toluenesulphonic, benzenesulphonic, naphthalenesulphonic or naphthalenedisulphonic), 25 salicylic, glutaric, gluconic, tricarballylic, mandelic, cinnamic, substituted cinnamic (for example, methyl, methoxy, halo or phenyl substituted cinnamic, including 4-methyl and 4-methoxycinnamic acid and α -phenyl cinnamic acid (E or Z isomers or a mixture of the two)), ascorbic, oleic, naphthoic, hydroxynaphthoic (for example 1- or 3-hydroxy-2-naphthoic), naphthaleneacrylic (for example naphthalene-2-acrylic), benzoic, 4-methoxybenzoic, 2- or 4-30 hydroxybenzoic, 4-chlorobenzoic, 4-phenylbenzoic, benzeneacrylic (for example 1,4-benzenediacylic) and isethionic acids. Pharmaceutically acceptable base salts include ammonium salts, alkali metal salts such as those of sodium and potassium, alkaline earth metal salts such as those of calcium and magnesium and salts with organic bases such as dicyclohexyl amine and N-methyl-D-glucamine.

The active ingredient drug substance is most preferably a selective long-acting β_2 -adrenoreceptor agonist. Such compounds have use in the prophylaxis and treatment of a variety of clinical conditions, including diseases associated with reversible airways obstruction such as asthma, chronic obstructive pulmonary diseases (COPD) (e.g. chronic 5 and wheezy bronchitis, emphysema), respiratory tract infection and upper respiratory tract disease (e.g. rhinitis, including seasonal and allergic rhinitis).

Other conditions which may be treated include premature labour, depression, congestive heart failure, skin diseases (e.g. inflammatory, allergic, psoriatic, and proliferative skin 10 diseases), conditions where lowering peptic acidity is desirable (e.g. peptic and gastric ulceration) and muscle wasting disease.

Preferred active drug substances for use in the present invention include those described in WO 02/066422, WO 02/070490, WO 02/076933, WO 03/024439, PCT/EP03/02301 and 15 PCT/EP03/04367, the contents of which are incorporated herein by reference as though set out in full herein. For example the drug substance may be 3-(4-{[6-((2R)-2-hydroxy-2-[4-hydroxy-3-(hydroxymethyl)phenyl]ethyl}amino) hexyl]oxy}-butyl)benzene-sulfonamide, for example as its cinnamate salt.

20 Formulations to which the present invention may be applied include those suitable for oral, parenteral (including subcutaneous, intradermal, intramuscular, intravenous and intraarticular, inhalation (including fine particle dusts or mists which may be generated by means of various types of metered dose pressurised aerosols, nebulisers or insufflators), rectal and topical (including dermal, buccal, sublingual and intraocular) administration 25 although the most suitable route may depend upon for example the condition and disorder of the recipient. The formulations may conveniently be presented in unit dosage form and may be prepared by any of the methods well known in the art of pharmacy. All methods include the step of bringing the active ingredient into association with the carrier and the ternary agent as well as any other accessory ingredients. In general the formulations are prepared 30 by uniformly and intimately bringing into association the active ingredient, lactose, ternary agent and any other accessory ingredients, and then, if necessary, shaping the product into the desired formulation.

35 Formulations of the present invention suitable for oral administration may be presented as discrete units such as capsules, cachets or tablets each containing a predetermined amount

of the active ingredient; as a powder or granules. The active ingredient drug substance may also be presented as a bolus, electuary or paste.

A tablet may be made by compression or moulding, optionally with one or more accessory 5 ingredients. Compressed tablets may be prepared by compressing in a suitable machine the active ingredient in a free-flowing form such as a powder or granules, optionally mixed with a binder, lubricant, inert diluent, lubricating, surface active or dispersing agent. Moulded tablets may be made by moulding in a suitable machine a mixture of the powdered compound moistened with an inert liquid diluent. The tablets may optionally be coated or 10 scored and may be formulated so as to provide slow or controlled release of the active ingredient therein.

Formulations for parenteral administration include sterile powders, granules and tablets intended for dissolution immediately prior to administration. The formulations may be 15 presented in unit-dose or multi-dose containers, for example sealed ampoules and vials, and may be stored in a freeze-dried (lyophilised) condition requiring only the addition of the sterile liquid carrier, for example saline or water-for-injection, immediately prior to use.

Formulations for rectal administration may be presented as a suppository with the usual 20 carriers such as cocoa butter or polyethylene glycol.

Formulations for topical administration in the mouth, for example buccally or sublingually, include lozenges comprising the active ingredient in a flavoured basis such as sucrose and acacia or tragacanth, and pastilles comprising the active ingredient in a basis such as gelatin 25 and glycerin or sucrose an acacia.

The invention finds particular application in dry powder compositions for topical delivery to the lung by inhalation.

30 Dry powder compositions for topical delivery to the lung by inhalation may, for example, be presented in capsules and cartridges of for example gelatine, or blisters of for example laminated aluminium foil, for use in an inhaler or insufflator. Packaging of the formulation may be suitable for unit dose or multi-dose delivery. In the case of multi-dose delivery, the formulation can be pre-metered (eg as in Diskus, see GB 2242134 or Diskhaler, see GB 35 2178965, 2129691 and 2169265) or metered in use (eg as in Turbuhaler, see EP 69715).

An example of a unit-dose device is Rotahaler (see GB 2064336). The Diskus inhalation device comprises an elongate strip formed from a base sheet having a plurality of recesses spaced along its length and a lid sheet hermetically but peelably sealed thereto to define a plurality of containers, each container having therein an inhalable formulation containing an active compound. Preferably, the strip is sufficiently flexible to be wound into a roll.

Medicaments for administration by inhalation desirably have a controlled particle size. The optimum particle size for inhalation into the bronchial system is usually 1-10 μm , preferably 2-5 μm . Particles having a size above 20 μm are generally too large when inhaled to reach the small airways. To achieve these particle sizes the particles of the active ingredient substance as produced may be size reduced by conventional means eg by micronisation. The desired fraction may be separated out by air classification or sieving. Preferably, the particles will be crystalline. In general, the particle size of the carrier, for example lactose, will be much greater than the drug substance within the present invention. It may also be desirable for other agents other than the active drug substance to have a larger particle size than the active drug substance. When the carrier is lactose it will typically be present as milled lactose, for example with a MMD of 60-90 μm and with not more than 15% having a particle diameter of less than 15 μm .

Preferred unit dosage formulations are those containing an effective dose, as hereinbefore recited, or an appropriate fraction thereof, of the active ingredient.

It should be understood that in addition to the ingredients particularly mentioned above, the formulations of this invention may include other agents conventional in the art having regard to the type of formulation in question, for example those suitable for oral administration may include flavouring agents.

The compounds and pharmaceutical formulations according to the invention may be used in combination with or include one or more other therapeutic agents, for example a beta-agonist may be used in combination with one or more other therapeutic agents selected from anti-inflammatory agents (for example a corticosteroid, or an NSAID,) anticholinergic agents (particularly an M₁, M₂, M₁/M₂ or M₃ receptor antagonist), other β_2 -adrenoreceptor agonists, antiinfective agents (e.g. antibiotics, antivirals), or antihistamines.

Suitable corticosteroids include methyl prednisolone, prednisolone, dexamethasone, fluticasone propionate, 6 α ,9 α -difluoro-17 α -[(2-furanylcarbonyl)oxy]-11 β -hydroxy-16 α -methyl-3-oxo-androsta-1,4-diene-17 β -carbothioic acid S-fluoromethyl ester, 6 α ,9 α -difluoro-11 β -hydroxy-16 α -methyl-3-oxo-17 α -propionyloxy-androsta-1,4-diene-17 β -carbothioic acid S-(2-oxo-tetrahydro-furan-3S-yl) ester, beclomethasone esters (e.g. the 17-propionate ester or the 17,21-dipropionate ester), budesonide, flunisolide, mometasone esters (e.g. the furoate ester), triamcinolone acetonide, rofleponide, ciclesonide, butixocort propionate, RPR-106541, and ST-126.

5

10 Suitable NSAIDs include sodium cromoglycate, nedocromil sodium, phosphodiesterase (PDE) inhibitors (e.g. theophylline, PDE4 inhibitors or mixed PDE3/PDE4 inhibitors), leukotriene antagonists, inhibitors of leukotriene synthesis, iNOS inhibitors, tryptase and elastase inhibitors, beta-2 integrin antagonists and adenosine receptor agonists or antagonists (e.g. adenosine 2a agonists), cytokine antagonists (e.g. chemokine antagonists) 15 or inhibitors of cytokine synthesis.

20 Suitable anticholinergic agents are those compounds that act as antagonists at the muscarinic receptor, in particular those compounds which are antagonists of the M₁ and M₂ receptors. Exemplary compounds include the alkaloids of the belladonna plants as illustrated by the likes of atropine, scopolamine, homatropine, hyoscyamine; these 25 compounds are normally administered as a salt, being tertiary amines.

25 Preferred anticholinergics include ipratropium (e.g. as the bromide), sold under the name Atrovent, oxitropium (e.g. as the bromide) and tiotropium (e.g. as the bromide) (CAS-139404-48-1).

30 Suitable antihistamines (also referred to as H₁-receptor antagonists) include any one or more of the numerous antagonists known which inhibit H₁-receptors, and are safe for human use. All are reversible, competitive inhibitors of the interaction of histamine with H₁-receptors. Examples of preferred anti-histamines include methapyrilene and loratadine.

35 The invention further provides the use of an inhalable solid pharmaceutical formulation according to the invention for the manufacture of a medicament for the treatment of diseases associated with reversible airways obstruction such as asthma, chronic obstructive pulmonary diseases (COPD) (e.g. chronic and wheezy bronchitis, emphysema), respiratory

tract infection and upper respiratory tract disease (e.g. rhinitis, including seasonal and allergic rhinitis). The invention also provides a method for treating asthma, chronic obstructive pulmonary diseases (COPD), chronic or wheezy bronchitis, emphysema, respiratory tract infection upper respiratory tract, or rhinitis, including seasonal and allergic

5 rhinitis comprising administering to a patient in need thereof an inhalable solid pharmaceutical formulation according to the invention.

In a further aspect, the invention provides a method of preparing a solid pharmaceutical preparation comprising combining in one or more steps: (a) an active ingredient substance

10 susceptible to interaction with a carrier, (b) a carrier and (c) calcium stearate.

Examples

Test compound

15 In the following examples, the drug compound, "Compound X" was the cinnamate salt of 3-(4-{{[6-((2R)-2-hydroxy-2-[4-hydroxy-3-(hydroxymethyl)phenyl]ethyl)amino}hexyl}oxy}-butyl)benzene-sulfonamide. The synthesis of compound X is described in Examples 45 and 46 in WO 02/066422.

20

Method

Preparation of blends

25 Lactose monohydrate was obtained from Borculo Domo Ingredients as BP/USNF form. Before use, the Lactose Monohydrate was sieved through a coarse screen (mesh size 500 microns). Compound X was micronised before use in an APTM microniser to give a MMD (mean mass diameter) of from 2 to 5 microns.

30 Calcium stearate was obtained from Sigma-Aldrich and used as supplied.

The calcium stearate was combined with lactose monohydrate and blended using either a high shear mixer (a QMM, PMA or TRV series mixer) or a low shear tumbling blender (a Turbula mixer) to provide a ternary agent/drug premix, hereinafter referred to as blend A.

35

Final blend B was obtained by first pre-mixing an appropriate quantity of blend A with compound X and then blending that blend A/compound X premix with further blend A in a weight ratio appropriate to provide blend B containing the calcium stearate in the required quantity, as indicated in Table 1 below. The quantity of calcium stearate in Table 2 is the 5 amount by weight of calcium stearate present as a percentage of the total composition. The final concentration of compound X in the blends was 0.1% w/w calculated on the basis of the weight of free base drug present.

10 The quantity of the various materials used in the various blends are shown in Table 1:
Table 1

| Excipient | Mass of excipient | Mass of compound X | Mass of lactose |
|----------------|-------------------|--------------------|-----------------|
| None | - | 0.14g | 99.86g |
| 2% Ca stearate | 2.00g | 0.14g | 97.86g |

Decomposition conditions

15 The blends prepared as described above were subjected to accelerated decomposition conditions in a controlled atmosphere stability cabinet. In the tables below, the conditions to which the blends were subjected are given with reference to the temperature and the % relative humidity, for example 30/60 is 30°C and 60% relative humidity. Samples were analysed for decomposition products after the time periods indicated in the tables.

20 **Analysis of purity of blends after subjection to decomposition conditions**

LC analysis was conducted on a Supelcosil ABZ+PLUS column (150 x 4.6mm ID), 3 micron, eluting with water containing 0.05% trifluoroacetic acid (solvent A) and acetonitrile containing 0.05% v/v trifluoroacetic acid (solvent B), using the following elution gradient: time 0 = 90% solvent A, 10% solvent B; 40 mins = 10% solvent A, 90% solvent B; 41-45 mins 90% solvent 25 A, 10% solvent B, . Flow rate was 1ml/min and the column temperature was 40°C. Detection was carried out by UV at 220nm with a HP1100 series detector model G1314A-VWD. The area under the LC trace curve for the total impurities was compared with the total area under the curve, to give the %area/area figures given in Table 2.

Results**Example 1: Comparison of compound X / lactose blends comprising calcium stearate with controls**

5 Table 2:

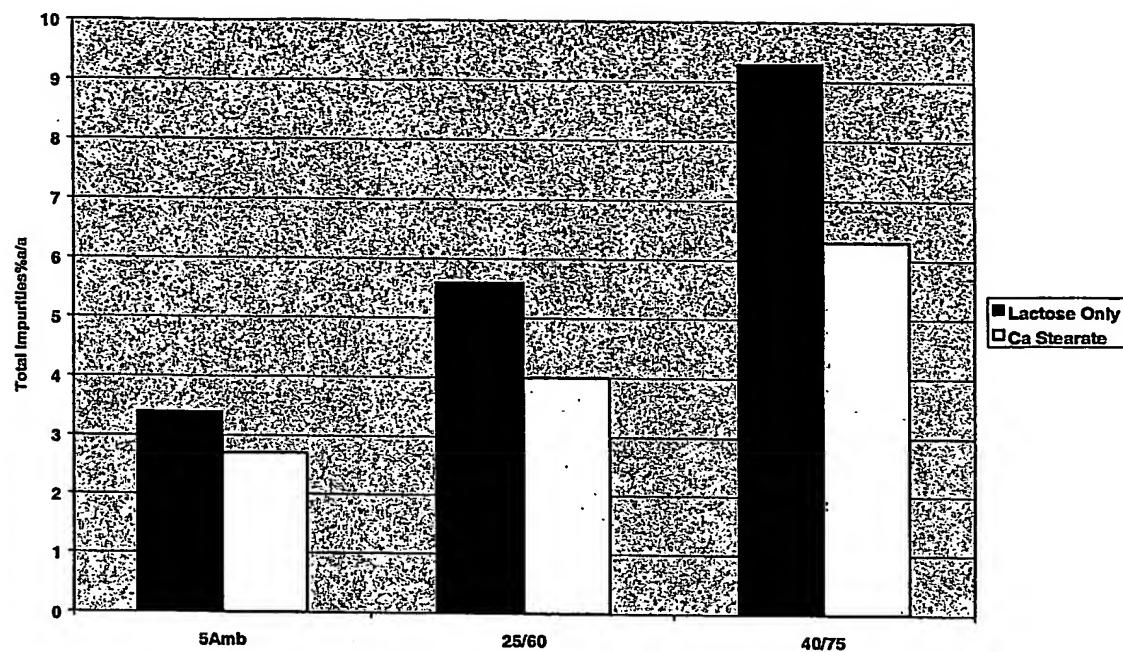
| Blend Details | Timepoint | Condition | Total Impurities (% area/area) |
|---|-----------|-----------|-----------------------------------|
| Compound X with Lactose only | 1 Month | 5/Amb | 3.4 |
| | | 25/60 | 5.6 |
| | | 40/75 | 9.3 |
| Compound X with Lactose and 2% Calcium Stearate | 1 Month | 5/Amb | 2.7 |
| | | 25/60 | 4.0 |
| | | 40/75 | 6.3 |

The data in Table 2 are shown graphically in Figure 1.

CLAIMS

1. Use of calcium stearate to inhibit or reduce chemical interaction between an active ingredient substance and a carrier in a solid pharmaceutical formulation, wherein the active ingredient substance is susceptible to chemical interaction with the carrier.
5
2. Use of calcium stearate to inhibit or reduce chemical degradation of an active ingredient substance in a solid pharmaceutical formulation comprising the active ingredient substance and a carrier, wherein said active ingredient substance is susceptible to chemical interaction
10 with said carrier.
3. Use as claimed in claim 1 or claim 2 wherein the carrier is a reducing sugar.
4. Use as claimed in claim 3 wherein the carrier is lactose.
15
5. Use as claimed in any one of claims 1 to 4 wherein the calcium stearate is present in an amount of from 0.1 to 20% w/w based on the total weight of the composition.
6. Use as claimed in any one of claims 1 to 5 wherein the active ingredient substance is present in an amount of from 0.01% to 50% w/w based on the total weight of the composition.
20
7. Use as claimed in any one of claims 1 to 6 wherein the drug substance is one which includes the group Ar-CH(OH)-CH₂-NH-R.
25
8. Use as claimed in any one of claims 1 to 7 wherein the solid pharmaceutical formulation is for administration by inhalation.
9. An inhalable solid pharmaceutical formulation comprising (a) an active ingredient substance susceptible to chemical interaction with lactose, (b) a carrier and (c) calcium stearate.
30
10. An inhalable solid pharmaceutical formulation as claimed in claim 9 further comprising one or more of the features described in any one or more of claims 3 to 8.

11. A method of reducing or inhibiting chemical interaction between an active ingredient substance and a carrier susceptible to chemical interaction, which comprises mixing calcium stearate with said active ingredient substance and said carrier.
- 5 12. A method of inhibiting chemical degradation of an active ingredient substance in a formulation comprising a carrier and an active ingredient substance, which method comprises mixing calcium stearate with said active ingredient substance and said carrier.
- 10 13. A method as claimed in claim 11 or 12 further comprising one or more of the features described in any one or more of claims 3 to 8.
- 15 14. Use of an inhalable solid pharmaceutical formulation as claimed in claim 9 or 10 for the manufacture of a medicament for the treatment of asthma, chronic obstructive pulmonary disease (COPD), chronic or wheezy bronchitis, emphysema, respiratory tract infection, upper respiratory tract disease or rhinitis, including seasonal and allergic rhinitis.
- 20 15. A method for treating asthma, chronic obstructive pulmonary disease (COPD), chronic or wheezy bronchitis, emphysema, respiratory tract infection, upper respiratory tract disease, or rhinitis, comprising administering to a patient in need thereof an inhalable solid pharmaceutical formulation as claimed in claim 9 or 10.
16. A method of preparing a solid pharmaceutical preparation comprising combining in one or more steps: (a) an active ingredient substance susceptible to interaction with a carrier, (b) a carrier and (c) calcium stearate.



5

Figure 1

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